California Environmental Protection Agency
Department of Pesticide Regulation

Volatile Organic Compounds in Pesticides

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Agenda

- Background
- Method for Estimating VOC Emissions
- Amount of Pesticide VOC Emissions – Inventory
- Uncertainties in Emission Estimates
- Next Steps

VOCs and Air Pollution

- Volatile organic compounds (VOC) and nitrogen oxides (NOx) react with sunlight to form the air pollutant ozone
- Ozone causes respiratory irritation and illnesses; state standard 0.09 ppm for 1-hour
- Many pesticide active and inert ingredients are VOCs
- The Department of Pesticide Regulation (DPR) and the Air Resources Board (ARB) develop plans and take actions to estimate and reduce VOC emissions from pesticides

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Sources of VOCs

- Numerous sources of VOCs such as vehicles, manufacturing, consumer products, agriculture
- Relative contribution of the sources varies with area and year
- San Joaquin Valley has highest contribution from agricultural sources; top sources in 1999:
  1) Livestock wastes
  2) Light duty passenger vehicles
  3) Light and medium duty trucks
  4) Oil and gas production
  5) Agricultural pesticides

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State Implementation Plan

- As required by the Clean Air Act, ARB and Air Pollution Control Districts (APCD) develop State Implementation Plans (SIP) to reduce VOCs and NOx
- 1994 SIP requires DPR to reduce VOC emissions from pesticides by 20% between 1990 and 2005 in 5 nonattainment areas

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Nonattainment Areas

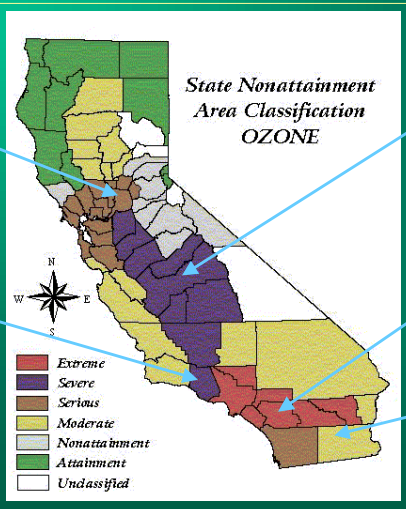
Sacramento Metro

San Joaquin Valley

Ventura

South Coast

Southeast Desert



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Method for Estimating VOCs

- DPR maintains an inventory of VOC emissions from agricultural and commercial structural applications of pesticide products
- VOC emission from a pesticide product is:

  emission = %VOC in product x amount of product

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Estimating %VOC in Products

- In 1994, DPR requested %VOC (emission potential) data for all agricultural and structural products
- Emission potential for each product determined by one of four methods:
  - Lab test (thermogravimetric analysis, TGA)
  - Water/Inorganic subtraction
  - Estimated from confidential statement of formula
  - Default value

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Default Emission Potentials

- DPR has estimated emission potentials for 27% of the 11,000+ products included in the inventory by TGA, water/inorganic subtraction, or CSF.
- Remaining 73% of the products are assigned a default value based on formulation category
  - Old Default: highest TGA value
  - New Default: median TGA value
  - Highest value used to encourage submission of data
  - Median value used to obtain best estimate of emissions

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Default Emission Potentials (%)

Formulation Category	New	Old
DUST/POWDER	1.53	59.7
EMULSIFIABLE CONCENTRATE	39.15	98.7
FLOWABLE CONCENTRATE	4.80	95.8
GRANULAR/FLAKE	3.70	20.3
OIL	3.47	3.90
PELLET/TABLET/CAKE/BRIQUET	5.18	8.2
PRESSURIZED PRODUCTS	100	100
SOLUBLE POWDER	1.15	5.3
SOLUTION/LIQUID (READY-TO-USE)	7.30	99.9
WETTABLE POWDER	1.85	9.2
SUSPENSION	5.71	9.4
DRY FLOWABLE	1.02	5.8
LIQUID CONCENTRATE	5.71	97.3

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Estimating Amount of Product

- VOC emission from a pesticide product is:
  emission = emission potential x amount of product
- Amount of product determined from pesticide use reports
- Pesticide use reports contain information on
  - Product applied
  - Amount applied
  - Date of application
  - Location of application
  - Commodity or site treated

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Pesticide Use Reports (PUR)

- Since 1990, all agricultural pesticide applications must be reported to the county agricultural commissioner
- Partial reporting of structural, industrial, institutional, and other uses
- Ag commissioners transfer the data to DPR. DPR compiles and maintains a PUR database
- PUR database contains approximately 2 million records for each year

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Emission Inventory Calculations

- Using emission potential data and PUR data, VOC emissions from agricultural and commercial structural applications calculated statewide for all years beginning with 1990 base year.
- Each year of inventory updated annually based on most recent PUR data and emission potential data; approximately 1 year lag
- Inventory focuses on:
  - May – Oct (peak ozone period) for each year
  - 5 nonattainment areas

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Emission Inventory

- Sacramento Metro Nonattainment Area
- San Joaquin Valley Nonattainment Area
- Southeast Desert Nonattainment Area
- Ventura Nonattainment Area
- South Coast Nonattainment Area

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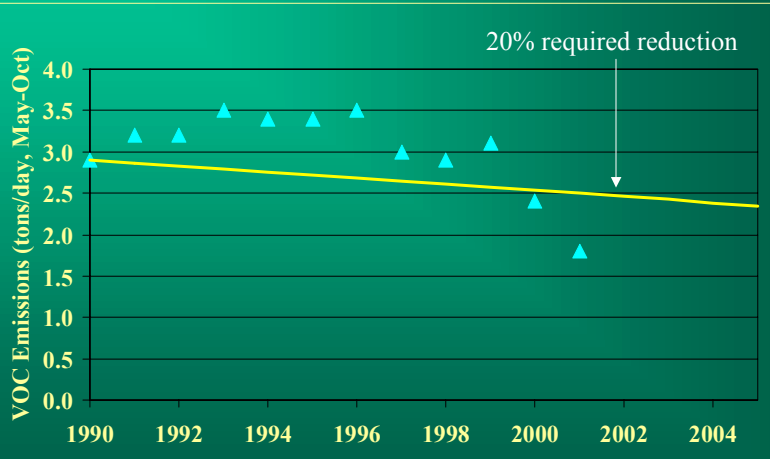
Sacramento Emission Inventory



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2001 Sacramento Emissions

- Pesticide inventory comprised of
  - 90% agricultural
  - 10% commercial structural
  - 27% fumigants
- Products with highest contribution contain
  - Metam-sodium
  - Molinate
  - Methyl bromide
  - Chlorpyrifos
  - Cypermethrin

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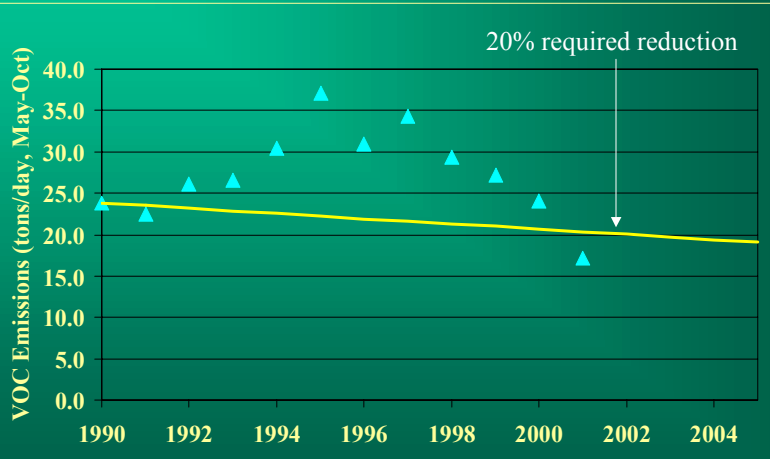
San Joaquin Emission Inventory



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2001 San Joaquin Valley Emissions

- Pesticide inventory comprised of
  - 98% agricultural
  - 2% commercial structural
  - 52% fumigants
- Products with highest contribution contain
  - Metam-sodium
  - Dichloropropene
  - Methyl bromide
  - Chlorpyrifos
  - Oxyfluorfen

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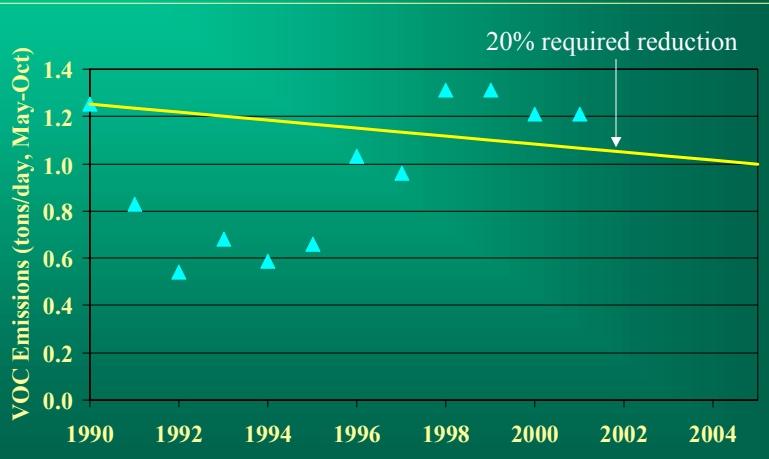
Southeast Desert Emission Inventory



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2001 Southeast Desert Emissions

- Pesticide inventory comprised of
  - 96% agricultural
  - 4% commercial structural
  - 83% fumigants
- Products with highest contribution contain
  - Metam-sodium
  - Methyl bromide
  - Dichloropropene
  - Gibberellins
  - Hydrogen cyanamide

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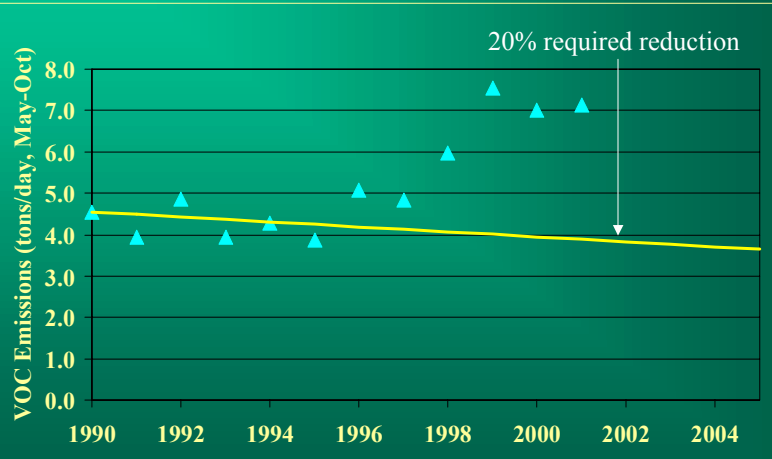
Ventura Emission Inventory



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2001 Ventura Emissions

- Pesticide inventory comprised of
  - 99.7% agricultural
  - 0.3% commercial structural
  - 88% fumigants
- Products with highest contribution contain
  - Methyl bromide
  - Dichloropropene
  - Metam-sodium
  - Chlorpyrifos
  - Chloropicrin

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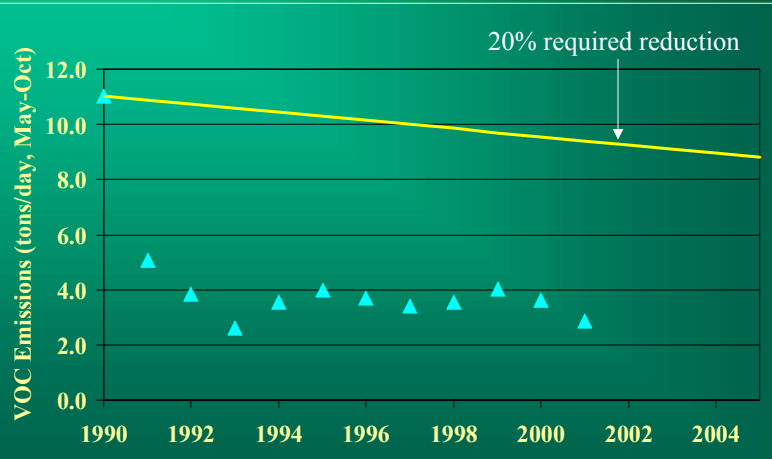
South Coast Emission Inventory



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2001 South Coast Emissions

- Pesticide inventory comprised of
  - 57% agricultural
  - 43% commercial structural
  - 35% fumigants
- Products with highest contribution contain
  - Methyl bromide
  - Diazinon
  - Chlorpyrifos
  - Permethrin
  - Metam-sodium

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Summary of Emission Inventory

- 2001 emissions meet the 2005 goal in 3 nonattainment areas: Sacramento Metro, San Joaquin Valley, and South Coast
- 2001 emissions do not meet the 2005 goal in 2 nonattainment areas: Southeast Desert and Ventura
- All 5 nonattainment areas must meet the 2005 goal in 2005
- VOC emissions parallel pesticide use
- Fumigants are major contributors in all nonattainment areas

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Uncertainties in Emission Inventory

- Uncertainties in pesticide use
- Uncertainties in emission potentials
- Other uncertainties
- Effects of uncertainties

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Uncertainties in PUR

- Approximately 5% of the PUR records contain errors
- Uncertain compliance in reporting
- Likely greater number of errors and lower compliance in early 1990s

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Uncertainties in Emission Potentials

- Emission potentials are unknown for 73% of the products, comprising 20% of use in 1990, and 16% of use in 2001
- Inventory may include emission potential errors or inappropriate values; metam-sodium and sodium chlorate recently revised
- Emission potentials may not indicate actual emission rates in the field

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Other Uncertainties

- Limited data available to forecast future emissions
- The proportion of each chemical (active and inert ingredients) in the inventory (speciation profile) is uncertain
- Ability to create ozone (reactivity) for many pesticides is unknown; amount of reactive organic gases (ROG) is the critical parameter

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Current Speciation Profile – Top 10

Chemical	Contribution (%)
Methyl bromide	25.3
Methyl isothiocyanate	17.8
Unidentified active ingredients	13.9
Dichloropropene	11.3
Chloropicrin	8.6
Aromatic 200 solvent	4.8
Xylene range solvent	4.6
Molinate	3.3
Kerosene	1.7
Chlorpyrifos	1.7

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Effects of Uncertainties

- Base year has greater use of products with default emission potentials; changes in default values have greater impact on base year, relative to other years
- Base year emissions may be underestimated due to lower reporting compliance, relative to later years
- Base year varies from year to year
  - Base year changes when emission potential data revised
  - Base year changes when "improvements" incorporated
- San Joaquin Valley changed from meeting to not meeting the 1999 interim goal when default changed

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Next Steps

- Pesticide Emission Inventory
  - Obtain additional data to forecast emissions
  - Develop plan for determining more detailed speciation profiles and estimating ROG
  - Publish the next update, including the 2002 inventory, in late-2003 or early-2004

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Next Steps

- Regulatory Activities
  - South Coast and San Joaquin Valley will prepare new SIPs in 2003 that will describe measures to achieve air quality standards by 2010
  - South Coast will not need any additional VOC reductions from pesticides
  - San Joaquin Valley will need approximately 30% more VOC reduction from all sources between 1999 and 2010

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Opportunities for Stakeholders

- Emission Inventory
  - Provide data on emission potentials
  - Provide data on speciation and reactivity
  - Provide data on current and future pesticide use
- Reduction Activities
  - Work with DPR and ARB to develop options for reducing VOC emissions
  - Work with DPR and ARB to adopt practices that reduce VOC emissions

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Questions/Additional Information

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